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(54) THE: DYNAMIC IP ADDRESS ALLOCATION SYSTEM AND METHOD

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DYNAMIC IP ADDRESS ALLOCATION SYSTEM AND METHOD

BACKGROUND OF THE INVENTION Technical Field of the Invention

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more particularly, to a system and method for dynamically allocating Internet Protocol (IP) addresses to mobile terminals operating in a General Packet Radio Service This invention relates to telecommunications and data network systems and, (GPRS) network.

Description of Related Art

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When a Mobile Terminal (MT) accesses a GPRS network, a Packet Data

Protocol (PDP) Context Activation procedure is utilized to obtain an IP address for the MT. An initial request from the MT is sent to a Serving GPRS Service Node (SGSN) which forwards the request to a Gateway GPRS Service Node (GGSN). The GGSN Configuration Protocol (DHCP) server to authenticate the MT and obtain an IP of the Internet. IP addresses are becoming scarce, and the particular server that is the server may be down or maifunctioning, or there may be a problem with the link then interfaces over a Gi interface to either a Radius server or a Dynamic Host address. Several problems, however, arise when MTs attempt to obtain IP addresses with the existing procedures. First, because of the tremendous increase in the usage accessed by the GGSN may have exhausted its allocation of addresses. Alternatively, between the GGSN and the server. In any event, there may be times that an IP address cannot be provided to an MT.

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Service Provider (ISP). If the home ISP does not have an actual (public) IP address This solution, however, causes a second problem to become apparent with the existing In an effort to solve the problem of scarce IP addresses, the Internet Engineering Task Force (IBTF) has proposed a solution that uses alternative addresses chown as private IP addresses. Private IP addresses can be used unywhere. For example, if MT1 travels outside its home network, it may connect to its home Internet that it can provide to MT1, the home ISP may provide MT1 with a private IP address.

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procedures. When a second MT (MT2) connects to a different ISP, it may also be

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provided with private IP address. There is no deconfliction of private IP addresses between EN's to ensume that the same IP address is not given to more than one MT. Therefron, the EN's serving MT2 may provide the same private IP address to MT2 that was provided to MT1, changing a clash of IP addresses in the network.

Another IETF proposal defines a Nework Address (Tanalisor (NAT) in an attempt to concerne that problem. The Ald device temporally provides a global poblic P address. It also provides a private P address to unique public P address. It a party is provided with a private P address, the address on only be used within a private network utilizes. Null active is used to translate the address. This solution words fine for most applications, but does not work for real-time applications such as H.333 Volco-over, P (NAP). In VAIP, the IP addresses of the putties are contained in the projudal itself in addition to the paried based. The initiation may write, therefore, when MT1 is conducting a VolP sension with MT2, and MT1 sends on P packet in which the course address is a private IP address. The destination address is MT2* IP address (position or private). The AMT of store changes the source IP address is the lander to a temporary public IP address. Thus, there is on IP address minimated that course problems for real-time applications and as VolP.

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Another problem with existing mulched of allocating IP address is the unproficiohability of the Gi interface between the GGSN and the server from which IP addresses are requested. While the other interfaces in GPES (Get, Gr, Ge, etc.) are tightly controlled, the Gi interface is completely unpredictable.

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There we no known prior at teachings of a solution to the determentioned deficients sead shortcomings such as that disclosed bearin. In order to overcome the disadvantage of ordining solutions, it would be advantageous to have a system and method for dynamically allocating IP addresses to MTs in a GPES network that prevents IP address conflicts and provides addresses that are usuable to MTs running real-time applications and it with It haddening the system are nother and predictability into the GI interface. The present invention provides some order and predictability into the GI interface. The present invention provides

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such a system and method

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SUMMARY OF THE INVENTION

In one superf, the present inventions is a method of dynamically laborating an plant of the method of the Month of the State of State Stat

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In another aspect, the present invention is a method by which the GGSS dynamically learns the average time (17) and the average number of retries (by) to exchanging Radius unformationion measures with different informet Service Provident/Access Point Names (SSY/APNs). For those artivorist involving long delays, the GGSN may use a new signaling scheme to change the GGSN signifies time parameter Ti to ensure that the core packet network reflects the intent topology of the external SSY network.

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In another appect, the present invention is a method of dynamically allocating an IP address to a mobile terminal committing in a GPRS abstract that includes are SSSN serving the mobile terminal and a GGSN connecting the GPRS abroade to SSSN serving the mobile terminal and a GGSN connecting the GPRS abroade to server that allocates IP addresses in an IP-staced abstract. The method includes the stem of receiving in the CGSN, information regarding whether the mobile terminal is substantiated to metable terminal is substantiated to metable terminal is a most of a real-time application. The other cannot be convert, and whether the mobile terminal is a most of a real-time application. The other cannot be convert, and whether the mobile terminal is a most offer mobile and the GGSN a maximum time period (TI) that the GGSN and the GG

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he GGSN to the server. The method then sends a request for an IP address from the GGSN to the server. If it is determined that time period Ti expired without receiving a response from the server that includes an IP address for the mobile terminal, then it is further determined from the information in the GGSN whether the mobile terminal is authorized to receive a backup IP address. Upon determining that the mobile eminal is authorized to receive a backup IP address, the method determines from the information in the GGSN whether the mobile terminal is a user of a real-time application. If the mobile terminal is a user of a real-time application, this is followed by sending a public IP address from the GGSN to the mobile terminal. If the mobile terminal is not a user of a real-time application, the method sends a private IP address rom the GGSN to the mobile terminal instead.

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system also includes a timer in the GGSN for setting a maximum time period (Ti) that In yet another aspect, the present invention is a system for dynamically illocating an IP address to a mobile terminal operating in a GPRS network. The system includes a Home Location Register (HLR) that stores information regarding whether the mobile terminal is authorized to receive a backup IP address if an IP address cannot be obtained from the server, and wbether the mobile terminal is a user of a real-time application. The information is sent via an SGSN to the GGSN. The he GGSN will wait for a response from the server after a request for an IP address is cent from the GGSN to the server. A Network Access Server (NAS) in the GGSN ncludes means for sending a request for an IP address from the GGSN to the server, and means for determining that time period Ti expired without receiving a response from the server that includes an IP address for the mobile terminal. Additionally, the ystem includes means in the GGSN for determining from the information in the 3GSN whether the mobile terminal is authorized to receive a backup IP address, and if so, determining from the information in the GGSN whether the mobile terminal is s user of a real-time application. Finally, the system includes means for sending a sublic IP address from the GGSN to the mobile terminal upon determining that the nobile terminal is a user of a real-time application, and means for sending a private IP address from the GGSN to the mobile terminal upon determining that the mobile terminal is not a user of a real-time application.

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In yet another aspect, the GGSN is modified to filter and monitor the Gi

interface are provided with duplicate private IP addresses by different ISPs. If a nterface to ensure that no two mobile terminals currently sharing the same Gi second mobile terminal is given a duplicate IP address by another ISP, the GGSN ignals a rejection of that IP address to the ISP's Radius server, and requests the

provision of an alternate IP address.

the GGSN to the server. Each request is separated from the previous request by time In still yet another aspect, the present invention is a modified GGSN in a (Ni) of requests for an IP address that are to be sent from the GGSN to the server, and from the server after each request for an IP address is sent. The GGSN also comprises a NAS that includes means for sending a sequence of requests for an IP address from period Ti, and the sequence is halted if a response is received from the server within time period Ti after one of the requests is sent. The NAS also includes means for terminal. Finally, the GGSN includes means for sending the IP address from the GPRS network. The GGSN dynamically allocates an IP address to a mobile terminal a timer for setting a maximum time period (T1) that the GGSN will wait for a response receiving a response from the server that includes an IP address for the mobile operating in the GPRS network and includes a counter for setting a maximum numb

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For Virtual Private Networks (VPNs), where the request for setting up a Layer a failure to receive a Radius Access Accept message within a certain time interval causes the GGSN to examine the Access Point Name (APN) and to deduce tunnel 2 Tunneling Protocol (L2TP) tunnel comes from the Radius server access response endpoint parameters for setting up the L2TP tunnel.

GGSN to the mobile terminal.

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BRIEF DESCRIPTION OF THE DRAWINGS

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The invention will be better understood and its numerous objects and idvantages will become more apparent to those skilled in the art by reference to the allowing drawings, in conjunction with the accompanying specification, in which: FIG. 1 is a signal flow diagram illustrating the flow of measuges when performing a first embodiment of the method of the present invention to allocate an

IP address from a Radius server to a mobile terminal

FIG. 2 is a signal flow diagram illustrating the flow of messages when performing a second embodiment of the method of the present invention to allocate and produces to a mobile terminal when the Radius server fails to provide on IP

FIG. 3 is a flow chart of the steps performed by the present invention to ensure that the same IP address is not assigned to more than one MT by multiple ISPs; and

that the same or but makes is not assigned as inside using other to by multiple sore, and FIG. 4 is a flow chart illustrating the steps performed by the present invention when updating timens in the core packet network to reflect the latest topology of

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention is a system and method for dynamically allocating IF

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external ISP networks

addresses on MTs in GPES network that prevents IP address comities and provides addresses that me usable to MTs running real-time applications such as VoIP. Additionally, the present invention provides a greater degree of predictability and control to the Gl interface.

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Disting the Plackess allocation plane, if the GGNN is small-to obtain an Plackess allocation plane, if the GGNN is small-to obtain an place at the most more than the resistance of the MT with an Plackess. The address provided may be a public Plackess or a private Plackess. Based on the MT's addression data in the HLR, or other designation that is design, a subscript ears some of VNOP or other real store applications, the invention provides that MT with a public IP address in the value of VNOP and the public IP address and the value of VNOP and the public IP address are not one of the address of the volume of the invention and or all the value of VNOP and LTTP turned parameters based on the ATM was that failure to receive a separate from a Radius server does not prevent LTTP turned sector. At the discretion of the application of the address of the application of the superior of the application of the superior operate, other may be a bright of daugs for the public in

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FIG. 1 is a signal flow diagram illustrating the flow of messages when

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preferrings (first ambodiment of the method of the present invention to allocate IP staffers to a mobile formation. The components of the system of the present invention are illustrated screen the top of the figure. A mobile terminal (PMT) 11 is served by us SCON 12. The SCON includes a siture (FD) 13 and a comment (PD) 13. The SCON communicates with a COGN 12 to gain access to us IP-based invented. In The SCON includes a New rithout Access Server (NAS) 17 that connected to the IP-based metwork. The NAS includes a new rithout (TD) 18, and a new connect (PD) 19. A phrallity of Endalis servers (RD) 20 to 20 to behaping us an internal Service Provides (SEP) was accessed by the GCON over the G1 interface 21 in order to obtain an IP.

The MY I lead an Actions PIP Contact Reposts reasons 2 to the SCSSI
In a network the TIP Contact The SCSSI setup 17 and MY to come the time and
number of Crease PIP Contact Request reasons 2 to the all tends to the
GGSN 15 to create the PIP Contact. A response from the GGSN is required within
time 73. Using entiring procedures, it a response is not received where 71 expires
the arthronion is a failure, and the MY do not received where 71 expires
the strivation is a failure, and the MY do not receive the My the MY to the strip of the MY to t

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address for the MT.

20 Upon receiving the first Create PDP Center Request message \$28, the GGSN center Request message \$28. The GGSN center Request message is unicate to an identified RS. This may be directlink, or the message may pass through several neuters. The GGSN construct a Network Accord Stuffing (AVI) and included to the NAI the Relatified (AVI) and included to the NAI the Relatified (AVI) and included to the NAI the Relatified (AVI) and the provides a time that for exercise a received the Configuration of the NAI. Existing providents do not provide a time little for exercise a resource on the NAI. Existing providents do the provides the little first receiving a resource of the SA and there is no provision for reposing the message if it response was no received. The GGSN mently while for a compose until the T3 time 13 expirits in the SGSN, and the IP debtase allocation provises him.

The present invention adds the Ti timer 18 and the Ni counter 19 to the GGSN

RS. The Ti timer may expire if the RS takes too long to perform its authentication functions and to find an IP address. If no response is received before Ti expires, the 3GSN repeats the Radius Access Request message for a total of Ni times. FIG. 1 illustrates an exemplary scenario in which the Radius Access Request message is to bring some order and predictability into the Gi interface. The other interfaces in GPRS (Gs, Gr, Gn, etc.) are tightly controlled, but the Gi interface is completely unpredictable. Ti is the time period that the GGSN will wait for a response from the repeated three times as messages 24a, 24b, and 24c are sent to the RS. Thus, the total time that the GGSN may spend trying to get a response from the RS is Ti x Ni. Note

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Note also that Ti and Ni can be added to any NAS to improve its performance. NASs are utilized for network access by any ISP, and are widely used in applications

other than GPRS.

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that Ti x Ni must be less than time T3.

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Each time that the Radius Access Request message is repeated, it may be unicast to the same RS or to a different RS. FIG. 1 illustrates the example in which each Radius Access Request message is sent to a different RS. After the last Radius Access Request message 24c is sent, and no response is received, timer T3 in the GSN may expire. The SGSN may then send another Create PDP Context Request message 23b to the GGSN, depending on the setting of counter N3. At this point, the GGSN sends another Radius Access Request message 25 to the RS. In the example shown in FIG. 1, the RS 20a performs its authentication functions and provides an IP address in a Radius Access Accept message 26 prior to the expiration of Ti. The 3GSN then returns a Create PDP Context Response message 27 to the SGSN, and the SGSN provides the IP address to the MT in an Activate PDP Context Accept message

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FIG. 2 is a signal flow diagram illustrating the flow of messages when performing a second embodiment of the method of the present invention to allocate an IP address to a mobile terminal when the Radius server fails to provide an IP address. In the example shown in FIG. 2, the GGSN sends a second sequence of Radius Access Request messages 25a to 25c to the RS, and the RS fails to provide an P address before Ti expires at 29 following Radius Access Request message 25c,

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which is the final message allowed by Ni. Once Ti and Ni have expired, the present invention provides an IP address to the MT utilizing the following procedures.

router. The CPA parameter may be implemented as a 2-bit field in the PDP Context lata. The CPA parameter indicates whether the subscriber is entitled to a backup IP address in case of failure to obtain one over the Gi interface. If so, it is also used to If it is a private IP address, a NAT is required as part of the GGSN's Gi interface record of the user subscriber data. The first bit is a binary "Yes" or "No" to allow or whether the user is allowed to use real-time applications, and thus whether the user A new parameter called the Conditional PDP Address (CPA) parameter is stored in the MT's Home Location Register (HLR) 31 as part of the user subscriber determine whether the backup IP address is a private IP address or a public IP address. deny the user a contingency IP address in case of failure. The second bit indicates

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During the GPRS Attach procedure, the subscriber's record is sent by the HLR to the SGSN at step 32. In those cases where dynamic addresses are allowed, the SGSN sends relevant fields to the GGSN, including the new CPA field and the hould be allocated a public or private IP address. 2

existing field "Dynamic Address". The SGSN sends these fields in the Create PDP pueried for the IP address. Additionally, as a Network Access Server (NAS), the Context Request message 33a (and 33b if required) and then starts timer T3. The GGSN examines the Create PDP Context Request message to determine whether CPA is enabled. If so, it sends the first Radius Access Request message 24a in a sequence of messages to the RS and starts timer Ti. Alternatively, a DHCP server may be 3GSN may have an internal pool of addresses. 23

wither a public IP address or a private IP address. The GGSN has a limited number of Upon expiration of timer Ti and counter Ni at step 29, if the GGSN has not received an acknowledgment message from the RS, the GGSN determines that there is a failure of the Gi interface, and at step 34 determines from the CPA field whether in address from the RS. Based on the second bit in the CPA field, the GGSN allocates sublic IP addresses that it can provide. Therefore, the present invention utilizes this nethodology to ensure that public IP addresses are provided only to those users who the user is authorized to receive a contingency IP address in case of failure in receiving

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really require a public address for real-time applications

The GGNN then mode a Create RPP Connect Response messages 34 to the SGNN undistributed the entiting "Request Accepted" information element. In adultion, a new information element salled the CPA, Assigned (AA) information in Element is included to inform the SGNN of the P address being provided and any limitations of the new IP address for the MT. Automatively, the GTP information element "Private Extension" may be unificial for this purpose.

Optionally, the SGSN may insert the CA information element in the Activat

PDP Contact Accept enough 25 that it sends to the ART than storifying the ART than a different priefat is being used for the FP address. Once the MT receives the IP address, it can Ilumeh any FP based application. If a public FP address has been provided, the MT can limeth early prediction applications such as VoRP. It is preferable to provide as FP address to the ART with a prediction to the ART with the assen notwork priefa at the ART home address. For MT1 using new private FP addresses to access their conpense LANs, if no tunned attribute are returned in the Ration response, the GOSN can contain the APN at the 59.7 and tain these parameters to content a VFN usual to a mortise that and can optionally examine the CA and AFN parameters to determine whether to signal the core reservoir, to center to MA-50-NAS immediacle connection between the GOSN and the contamply total entrowly. This assertment fifter electricities withing to secons their component to mail server, the substituted SFP address and the component network are not

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For private IP connectivity, the funded connection requires an agreement between the Public Land Mohle Network (PLAND), the SIY and the component LAM for alternate routes for connectivity. This is because corporate networks only affinite rattle by multimological users, and only allow rattle from certain ISPs or GPRS. operators. Traffict and therm be component sewerch stammford between the component was also also the control (PRS) sework. The authorization for the GPRS to set up the Yumed, and the alternate routes to the component LAM may be command in the Access Patrick Years (APS)-based Domain Name's Server (DNS) record.

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FIG. 3 is a flow chart of the steps performed by the present invention to ensure that the same IP address is not assigned to more than one MT by multiple ISPs. The

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GOSI filters on all Gitterfriese to estate that to two activated mobile terminals are allocated the estate private platers, A targe 41, the GOSIN 5 domain an P address for a first MT from a first 1SP Radius server. At step 42, the GOSIN dobains on P address for a second MT from a second ISP Radius server. If it is determined at 43 that the record P address not the same as the first P address, the process moves to step 44, and to ocition is about. However, if the second P address is determined to be step 44, and to ocition is about. However, if the second P address is determined to be step 44, and to ocition is about a 14, the GOSIN may perform an accounting sent and adoption private P address at 43, the GOSIN may perform an ocity to request step at 45 to rectaor be assoint out the tophicated P address. The GOSIN the sents are conducted access Request message to the record ISP Radius server in order to request

another private IP address from the second server at 46. The IP addresses are compared until the GGSN ensures that duplicate addresses are not allocated.

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FIG. 4 as a flow clear liberating the steps performed by the present investion when updating stores in the core product network to reflect the flower product growing to cuternal IST networks. The method of the present investion canable the GOSN to collect time character materials for different IST-APVA, et al. if time? I toquathy copiere while variing for a response, Timp be updated, and the GOSN my significate the second of the copiere while variing for a response, Timp be updated, and the GOSN my significate the second of the copiere while variing for a response, Timp be updated, and the GOSN my significant the copiere that Tim 1 AVI) and the copiere that Tim 1 AVI) and the copiere that Tim 1 AVI) and the copiere that Tim 1 AVI) are the copiered that Tim 1 AVII and the COSN TIM I Residual AVII and the COSN TIM I AVII and AVII and

server separated by time Ti. At 52, the GGSN collects statistics on the time required

20 to receive responses, have delto time II recyters, and show many attempts are required. The GOSN exhalts as a wrange tember of timengs (NO) and an average time for free reponse (IV). At S, the GOSN exhalts as new selfing for the I Storier in the SGSN, which should be general than Nr. IT. Ar's, the GOSN self-time in the SGSN, which should be general than Nr. IT. Ar's, the GOSN self-time in the SGSN, which should be greater than Nr. IT. Ar's, the GOSN self-time in the SGSN adjust litter I I measure to the GOSN at many of the present the GOSN at mapped to a specific SEVAPN, the GOSN and send the Adjust Timer IT measure to any SGSN from which a SOAN in attempting to perform a PSP Gornest relations and whim in Parforse. Thus, at S7, the GOSN and send the Adjust Timer IT of measure to the SGSN from which a SOAN in the GOSN and send the Adjust Timer IT of measure to the SGSN from which a SOAN attempting to perform a PSP Gornest relation and whim the Portices. Thus, at S7, the COSN and the Adjust Timer IT and the SGSN and trapent the timer update process with them.

30 It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the system and method shown

and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the scope of the invention as defined in the following claims.

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WHAT IS CLAIMED IS:

A method of dynamically allocating an Internet Protocol (IP) address

- said GPRS network having a Serving GPRS Service Node (SGSN) serving the mobile to a mobile terminal operating in a General Packet Radio Service (GPRS) network, terminal and a Gateway GPRS Service Node (GGSN) connecting the GPRS network to a server that allocates IP addresses in an IP-based network, said method comprising s
- setting on a counter in the GGSN, a maximum number (Ni) of requests for an setting on a timer in the GGSN, a maximum time period (Ti) that the GGSN IP address that are to be sent from the GGSN to the server, 9
- sending a sequence of requests for an IP address from the GGSN to the server, with each request being separated from the previous request by time period Ti, said sequence being halted if a response is received from the server within time period Ti will wait for a response from the server after each request for an IP address is sent; 2
- receiving in the GGSN, a response from the server that includes an IP address for the mobile terminal within time period Ti after one of the requests is sent; and

ther one of the requests is sent;

sending the IP address from the GGSN to the mobile terminal.

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- The method of claim 1 wherein the step of sending a sequence of requests for an IP address from the GGSN to the server includes unicasting each of the requests in the sequence from the GGSN to a different server. 4
- The method of claim 1 wherein the step of sending a sequence of requests for an IP address from the GGSN to the server includes sending a sequence of requests from the GGSN to a Radius server. z
- The method of claim 1 wherein the step of sending a sequence of requests for an IP address from the GGSN to the server includes sending a sequence of requests from the GGSN to a Dynamic Host Configuration Protocol (DHCP) server.

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 The method of claim 1 further comprising the steps of: determining that the GGSN did not receive a response from the server within time period Ti after a last request was sent; and

allocating an IP address from an internal pool in the GGSN.

6. The method of claim 1 further comprising updating times in the GPRS network to reflect actual response times experienced by the GGSN when requesting IP addresses from the server.

 The method of claim 6 wherein the step of updating timers in the GPRS network includes the steps of:

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collecting statistics by the GGSN on the actual response time to receive responses from the server, how often time period Ti is exceeded, and how many requests are sent before a response is received;

extermining by the GGSN as average number of requests (No) required to receive a response from the server, and an average time (17) to receive a response; calculating by the GGSN new setting for a '17 timer in the SGSN, and sensiting the new setting for the T3 timer from the GGSN to the SGSN.

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- 25 9. A medios of olynomically allocating in Internet Procool (P) address to a mobile tentinal operating in a General Packet Radio Service (GPRS) network, and GPRS network sharing a Serving GPRS Service Node (GOSN) serving the mobile terminal and a Gateway GPRS Service Node (GOSN) connecting the GPRS network to a server that allocates IP addresses in an IP-based network, said method comprising

receiving in the GGSN, information regarding whether the mobile terminal is

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emborized to receive a backup IP address if an IP address cannot be obtained from the server, and whether the mobile terminal is a user of a real-time application; senting on a timer to the GGSN, a maximum time period (TI) that the GGSN will wait for a response from the server after a request for an IP address is sent from

will wait for a response from the server after a request for an IP address is sent fi the GGSN to the server;

sending a request for an IP address from the GGSN to the server

determining that time period Ti expired without receiving in the GGSN, a response from the server that includes an IP address for the mobile terminal; determining from the information in the GGSN whether the mobile terminal

determining from the information in the GGSN whether the mobile terminal

10 is authorized to receive a backup IP address;

upon determining that the mobile terminal is authorized to receive a buckup IP address, determining from the information in the GGSN whether the mobile terminal is a user of a real-time application;

sending a public P address from the GOSN to the mobils terminal upon determining that the mobile terminal is a user of a real-time application; and sending a private P address from the GOSN to the mobile terminal upon determining that the mobile terminal is not a user of a real-time application.

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In Amelood of dynamically ullocating an internet Procoso (Dynathess to a mobile terminal speciality in a General Decket Each Ger-Ger (GPES) neversk, and GPRS network having a Serving GPRS Service Node (GOSN) serving the mobile terminal and a Garway (GPRS Service Node (GOSN) connecting the GPRS network to a server that allocates if a delectate in an IP-based network, said method comprising the steps of:

- 25 setting on a counter in the GGSN, a maximum number (Ni) of requests for an IP address that are to be sent from the GGSN to the server;
- setting on a timer in the GGSN, a maximum time period (Ti) that the GGSN will wait for a response from the server after each request for an IP address is sent; senting a sequence of requests for an IP address from the GGSN to the server
- 30 with each request being separated from the previous request by time period Ti, said sequence being halted if a response is received from the server within time period Ti

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ifter one of the requests is sent;

determining that time period Ti expired following a last request in the sequence of Ni requests without receiving in the GGSN, a response from the server that includes

determining from the information in the GGSN whether the mobile terminal an IP address for the mobile terminal;

is authorized to receive a backup IP address;

upon determining that the mobile terminal is authorized to receive a backup IP address, determining from the information in the GGSN whether the mobile terminal is a user of a real-time application;

sending a public IP address from the GGSN to the mobile terminal upon sending a private IP address from the GGSN to the mobile terminal upon determining that the mobile terminal is a user of a real-time application; and 2

determining that the mobile terminal is not a user of a real-time application.

a mobile terminal operating in the GPRS network, said GPRS network including a In a General Packet Radio Service (GPRS) network, a Gateway GPRS Service Node (GGSN) for dynamically allocating an Internet Protocol (IP) address to Serving GPRS Service Node (SGSN) serving the mobile terminal, and said GGSN connecting the GPRS network to a server that allocates IP addresses in an IP-based tetwork, said GGSN comprising: 2 ន

a counter for setting a maximum number (Ni) of requests for an IP address that are to be sent from the GGSN to the server, a timer for setting a maximum time period (Ti) that the GGSN will wait for a response from the server after each request for an IP address is sent; a Network Access Server (NAS) that includes:

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means for sending a sequence of requests for an IP address from the GGSN to the server, with each request being separated from the previous request by ime period Ti, said sequence being halted if a response is received from the server within time period Ti after one of the requests is sent; and means for receiving a response from the server that includes an IP address for the mobile terminal; and

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means for sending the IP address from the GGSN to the mobile terminal

- The GGSN of claim 11 wherein the means for sending a sequence of requests for an IP address from the GGSN to the server includes means for unicasting each of the requests in the sequence from the GGSN to a different server.
- The GGSN of claim 11 wherein the means for sending a sequence of requests for an IP address from the GGSN to the server includes a Radius client for sending a sequence of requests from the GGSN to a Radius server.

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The GGSN of claim 11 wherein the means for sending a sequence of requests for an IP address from the GGSN to the server includes a Dynamic Host Configuration Protocol (DHCP) client for sending a sequence of requests from the GGSN to a DHCP server.

2

- GPRS Service Node (SGSN) serving a mobile terminal operating in the GPRS network, and a Gateway GPRS Service Node (GGSN) connecting the GPRS network to a server that allocates IP addresses in an IP-based network, a system for dynamically In a General Packet Radio Service (GPRS) network having a Serving allocating an Internet Protocol (IP) address to the mobile terminal, said system 8
- be obtained from the server, and whether the mobile terminal is a user of a real-time a Home Location Register (HLR) that stores information regarding whether the mobile terminal is authorized to receive a backup IP address if an IP address cannot
- means for sending the information to the GGSN,

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- a timer in the GGSN for setting a maximum time period (TI) that the GGSN will wait for a response from the server after a request for an IP address is sent from the GGSN to the server,
- means for sending a request for an IP address from the GGSN to the a Network Access Server (NAS) in the GGSN that includes:

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response from the server that includes an IP address for the mobile terminal; means for determining that time period Ti expired without receiving a

of a real-time application; whether the mobile terminal is authorized to receive a backup IP address, and if so, determining from the information in the GGSN whether the mobile terminal is a user means in the GGSN for determining from the information in the GGSN

upon determining that the mobile terminal is a user of a real-time application; and means for sending a private IP address from the GGSN to the mobile terminal means for sending a public IP address from the GGSN to the mobile termina

upon determining that the mobile terminal is not a user of a real-time application.

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operating in an access network, said system comprising: A system for dynamically allocating an IP address to a mobile terminal

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- allocates IP addresses in an Internet Protocol (IP)-based network, said NAS including a Network Access Server (NAS) connecting the access network to a server that an Authorization, Authentication, and Accounting (AAA) server that stores means for receiving an IP address from the server; and means for sending a request for an IP address to the server; and
- 23 terminal is a user of a real-time application; IP address if an IP address cannot be obtained from the server, and whether the mobile information regarding whether the mobile terminal is authorized to receive a backup
- upon determining that the mobile terminal is a user of a real-time application; and upon determining that the mobile terminal is not a user of a real-time application. means for sending a private IP address from the NAS to the mobile terminal means for sending a public IP address from the NAS to the mobile termina

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connecting the GPRS network to a plurality of servers that allocate IP addresses in an (IP) addresses to mobile terminals operating in the GPRS network, said GGSN Gateway GPRS Service Node (GGSN) for dynamically allocating Internet Protocol In a General Packet Radio Service (GPRS) network, a method in a

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P-based network, said method comprising the steps of:

obtaining a first IP address for a first mobile terminal from a first server, obtaining a second IP address for a second mobile terminal from a second

- duplicate IP addresses; determining whether the first IP address and the second IP address are
- releasing the second IP address upon determining that the first IP address and

the second IP address are duplicate IP addresses; and

as the first IP address obtaining a third IP address for the second mobile terminal that is not the same

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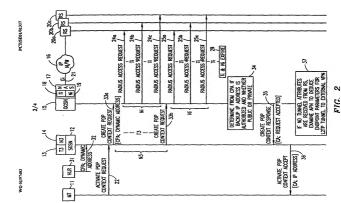
comprising the steps of: GPRS Service Node (GGSN) to a Virtual Private Network (VPN), said method dynamically setting up a Layer 2 Tunneling Protocol (L2TP) tunnel from a Gateway 18. In a General Packet Radio Service (GPRS) network, a method of

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- address from the GGSN to a server, each of the requests being separated by time (Ti): determining that time period Ti expired following a last request in the sequence sending a predetermined number (Ni) of requests for an Internet Protocol (IP)
- an IP address for the mobile terminal; and of Ni requests without receiving in the GGSN, a response from the server that includes

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endpoint parameters for setting up the L2TP tunnel examining by the GGSN, an Access Point Name (APN) to deduce tunnel



ACTIVATE POP CONTEXT REQUEST

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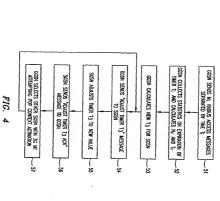


FIG. 3

GGSN OBTANS ANOTHER IP ADDRESS FROM SECOND SERVER

DUPLICATED IP ADDRESS FROM SECOND SERVER

IP ADDRESSES

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NO ACTION 44

SECOND MT FROM SECOND SERVER

GGSN OBTAINS IP ADDRESS FOR FIRST MT FROM FIRST SERVER

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(74) Ageot: BEAUCHESNE, Sandra; Ericsson Canada Inc., Dept.: LMCVIP 8400 Decrete Boalevard, Town of Moun-Royal, Queber, H4P 2N2 (CA). 2 (71) Applicace: TELEFONAKTIEBOLACET LM ERICS-SON (publ) (SESE): S-126 25 Stockbolm (SE).

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Investors: HUNG, Tran; 452 Laural Avenue. Town of Mount Royal (TMR), Quebec H;R 1P5 (CA),

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(54) THE DYNAMIC IP ADDRESS ALLOCATION SYSTEM AND METHOD

case of fallow to obtain one over the Gi insertine, and whether the MT is a user of a real-time application. A timer (18) in the GGSN uses a maximum time period (TI) that the GGSN will wait for a response from more subscriber data, and is passed to the GGSN during the GPRS Attach procedure. The CPA parameter indicates whether the subscriber is entitled to a backup IP address in # 8 8 8 RUDIS ACTESS VEQUEST / PAGUS ACCESS REGUEST / FUDIS ACCESS PROVEST / RUDIS ACCESS REDUEST ACCESS ACCEPT PAGES CONTLA RESPONSE CONTENT REGUEST 2 CONTRAIL POP

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INTERNATIONAL SEARCH REPORT

1PC 7 H04L29/66

International Application No. PCT/SE 01/01317

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A. FELLOS SELECTOR

Minimum documentation searched (classification system belowed by classification symbols)

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C. DOCUMENTS CONSIDERED TO SE RELEVANT

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Kistoffer Ogebjer 19 03 2002

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page 1 of 2

INTERNATIONAL SEARCH REPORT

Category * Casson of document, with Indication, where appropriate, of the relevant passes

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MALEAN IAN: "The wireless VPN:
Corporate access & services."
WRELESS AGENDA 2009, 5/1/2009, WORTEL
NETHORKS, INC., XP002902139
Austin, Texas
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Dage 5

WD 99 52237 A (VERTICLE NETWORKS INC ;PICKETT SCOTT K (US)) 14 October 1999 (1999-10-14) page 8, line 33 -page 9, line 19

9,10,15, 16 9,10,15, 18 C.(Centinuation) DOCUMENTS CONSIDERED TO BE RELEVANT PCT/SE 01/01317

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INTRINER DIFFORMATION CONTINUED FROM POTISSA, 218

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1. Chains: 1-16, 18

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Chain is Palate to dynamic allocation of Paddrasses comprising a time.

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Claim 17 relates to dynamic allocation of IP-addresses by obtaining IP-addresses and to detect duplicate IP-addresses.

2. Claim : 17

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